

been shown to be superior to measurements obtained from two-dimensional echocardiography (2DE). However, most of these studies were conducted in research setting with high volume 3DE use, selected cohort of patients and experienced sonographers.

Objectives: This study aimed to determine the accuracy and reproducibility of RT3DE and 2DE in measuring LV volumes and EF in daily clinical practice.

Methods: 30 patients (age 52 ± 12 years, 24 men, 29 in sinus rhythm, 23 with good acoustic window) undergoing clinically indicated cardiac magnetic resonance (CMR) imaging were prospectively recruited to have transthoracic 2DE and RT3DE performed within 4 hours after CMR. To assess inter-observer variability, 2 sonographers performed the same set of measurements independently on the same day. A subgroup of patients ($n = 10$) was studied for intra-observer variability. CMR was the reference standard.

Results: The LV end-diastolic volume (EDV), end-systolic volume (ESV), and EF measured from CMR were 194.3 ± 72.5 ml, 125.7 ± 69.0 ml and $37.8 \pm 19.2\%$ respectively. The biases \pm SD for RT3DE were -72.7 ± 45.7 ml, -47.6 ± 38.5 ml and $2.3 \pm 9.8\%$ for EDV, ESV and EF respectively. The biases \pm SD for 2DE were -70.5 ± 46.6 ml, -50.8 ± 42.4 ml and $5.7 \pm 9.5\%$ for EDV, ESV and EF respectively. The difference in bias between RT3DE and 2DE volumes was statistically not significant ($p = 0.54$ and $p = 0.47$ for EDV and ESV respectively). However, the difference in bias between RT3DE and 2D EF was marginally significant ($p = 0.05$). EF measured by CMR was similar by RT3DE ($P = 0.21$) but not by 2DE ($P = 0.003$). The inter- and intra-observer variation in volumes and EF were similar for RT3DE and 2DE.

Conclusions: In daily clinical practice, RT3DE and 2DE underestimates LV volumes. Compared to 2DE, RT3DE is more accurate for EF measurement. The reproducibility of RT3DE measurements is similar to that of 2DE.

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Importance of Calcium Score Zero in Predicting Presence of Obstructive Coronary Artery Disease and 2-Year Cardiovascular Outcome in Diabetic Patients: A Pilot Single-Centre Retrospective Study

E. Abdul Rahman, R. Najme Khir, N. Othman, S.C. Chuah, K.S. Ibrahim, C.W. Lim, M.K. Mohd Arshad, Z.O. Ibrahim, J.R. Ismail, H.A. Zainal Abidin, S.S. Kasim

Faculty of Medicine, UiTM Sg Buloh

Introduction: Diabetes is a major cardiovascular risk factors associated with significant morbidity and mortality. Little is known on diagnostic performance of calcium score (CAS) zero in refining cardiovascular (CV) risk prediction amongst Malaysians that were well-known with multiple co-morbidities.

Objective: We aim to test the diagnostic performance of CAS in a sample of diabetic Malaysian population presented with stable chest pain to an outpatient setting.

Method: This was a pilot, single-centre, retrospective study of patients referred for coronary CT angiography (CTCA) for investigation of stable chest pain in 2014. Their baseline clinical data such as demographics, CV risk profiles, CAS and CTCA results were obtained from electronic medical records. A combined clinical outcome of CV event, the need to undergo invasive coronary angiogram and revascularization over a period of 2 years were also traced.

Result: 130 patients with complete data were analyzed. The mean age was 54 ± 11.6 years. 49 patients were diabetics and 81 patients were non-diabetic. When CAS zero, only 1 out of 17 diabetic patients had obstructive CAD on CTCA which led to intervention. When CAS was more than zero, 16 out of 32 diabetic patients had obstructive CAD on

CTCA, of which 15 led to intervention. 1 patient declined intervention, treated medically and did not develop event. When coronary calcium is present there's 94.1% (95% CI 71.3 to 99.8%) and 93.8% (95% CI 69.7% to 99.8%) probability to developed obstructive CAD on CTCA and CV event within 2 years. When CAS zero, there's 94.4% (95% CI 71.1 to 99.1%) and 94.1% (95% CI 69.9% to 99.1%) probability to have non-obstructive CAD and be event-free for 2 years.

Conclusion: Absence of coronary calcification confers benefit in diabetic patients suggesting clinical utility of zero calcium score as risk stratification tool in a population already at high risk of CVD.

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Comparison of Adaptive Changes in the Right Ventricle Between Professional Footballers and Weekend Warriors

R. Najme Khir, N.Y.C. Chua, K.S. Ibrahim, J.R. Ismail, H.A. Zainal, C.W. Lim, K. Arshad, Z.O. Ibrahim, S. Kasim, E. Abdul Rahman

Faculty of Medicine, UiTM Sg Buloh, Malaysia

Background: Regular exercise is associated with cardiac remodeling. We examine if there were any differences in cardiac remodeling of the right ventricle (RV) between professional football players and "weekend warriors" (vigorous intensity exercise of METS 6 and above for at least 75 minutes a week).

Objective: To compare adaptive changes in the right ventricle between professional footballers and weekend warriors.

Materials Methods: 23 professional football players, 20 "weekend warrior" with no past medical problems were evaluated. The subject's age ranges from 20 to 40-years old. The subjects were evaluated by two-dimensional echocardiography and tricuspid annular plane systolic excursion (TAPSE), right ventricular ejection fraction (RVEF), right ventricle basal dimension, right ventricle mid dimension and tissue doppler systolic wave of tricuspid valve (TDs).

Results: There were no differences between the mean TAPSE of the football players ($2.38 \text{ cm} \pm 0.37$) and the weekend warriors ($2.25 \text{ cm} \pm 0.22$), the mean RVEF of footballers (53.7 ± 9.14) and the weekend warriors (53.11 ± 8.62) and the mean TDs of footballers ($11.3 \text{ cm/s} \pm 5.7$) and weekend warriors ($12.44 \text{ cm/s} \pm 1.23$). However significant differences were seen the RV dimensions between the mean basal RV of the footballers ($4.33 \text{ cm} \pm 0.39$) and weekend warriors ($3.47 \text{ cm} \pm 0.44$) and the mid RV of the footballers ($3.87 \text{ cm} \pm 0.62$) and weekend warriors ($3.17 \text{ cm} \pm 0.59$).

Conclusion: Exercise causes adaptive changes in right ventricles and these adaptive changes are dependent on the intensity and duration of exercise, where there are no significant differences in the RV function of the two distinct groups, but the RV dimensions are larger in the professional footballer groups.

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Indication, Safety and Clinical Impact of Cardiovascular Magnetic Resonance: A Pilot Run of the First National CMR Registry for Malaysia

K.H. Ho^a, N.H. Mohd Amin^a, N.A. Muhd Apipi^a, N.L. Husain^a, K.T. Koh^a, A. Said^b, F. Johari^c, A.Y.Y. Fong^a, T.K. Ong^a

^aCardiology Department, Sarawak Heart Centre, Sarawak

^bFaculty of Medicine and Health Sciences, University Malaysia Sarawak (UNIMAS), Sarawak

^cClinical Research Centre, Sarawak General Hospital

Background: Cardiovascular magnetic resonance (CMR) is a rapidly emerging noninvasive imaging technique providing high resolution images without any application of radiation. It has broad range of clinical applications and is increasingly been used in clinical practice in Malaysia. A national CMR Registry is needed to assess its practice in Malaysia.

Objective: To evaluate indications, safety and impact on patient management of CMR in Sarawak Heart Centre.

Materials Methods: A pilot run of CMR Registry in single centre with consecutive patients who underwent clinical CMR from January–June 2015. Retrospective data collection from CMR database and case notes.

Results: A total of 169 patients underwent clinical CMR, with 20 did not complete scan; 25% due to claustrophobia. 94% of patients received gadolinium-based contrast agent. Most important indications were viability assessment (54.4%), cardiomyopathy (28.2%), and risk stratification in suspected coronary artery disease (CAD) (4.7%). 6.7% of patients underwent stress MR (adenosine or dobutamine). Severe complications only occurred in 0.7% of the cases (anaphylactic reaction secondary to contrast agent). No mortality during/due to CMR. There was direct impact of CMR on the clinical management by confirming suspected diagnosis (59.1%), excluding suspected diagnosis (21.5%), providing additional information for suspected diagnosis which is confirmed or excluded (18.1%) and providing unsuspected completely new diagnosis (1.3%). Invasive coronary angiogram was avoided and diagnosis were excluded in all patients referred for risk stratification of suspected coronary artery disease. Invasive therapeutic procedures such as PCI, CABG, valve surgery were triggered in 49.6% of patients after CMR was done, regardless of indication. Out of 81 patients who underwent CMR for viability study, 76.5% were planned for revascularisation (CABG or PCI) with the rest were planned for optimal medical therapy only after the CMR.

Conclusions: The top indications of CMR in Sarawak are viability assessment, cardiomyopathy and risk stratification in suspected CAD, which differs from the EuroCMR registry results. This demonstrated the importance of establishing a national multicentre CMR registry in Malaysia, and subsequently substudy on specific conditions. With appropriate medical personnel training and patient selection, CMR is safe and has strong impact on clinical management.

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Diagnostic Performance of Calcium Score in Detection of Coronary Artery Disease and Prediction of 2-Year Cardiovascular Outcome

E. Abdul Rahman, R. Najme Khir, N. Othman, S.C. Chuah, K.S. Ibrahim, C.W. Lim, M.K. Mohd Arshad, Z.O. Ibrahim, J.R. Ismail, H.A. Zainal Abidin, S.S. Kasim

Faculty of Medicine, UiTM Sg Buloh, Malaysia

Introduction: Cardiovascular (CV) risk factors are highly prevalent in south east Asia and current risk scoring systems have been proven to have some drawbacks. Calcium score (CAS) has emerged as a potential marker to improve risk prediction in western population however data is lacking on its utility in Malaysia.

Objective: We aim to test the diagnostic performance of CAS in comparison to Framingham risk score (FRS) in a sample of Malaysian population presented with stable chest pain to an outpatient setting.

Method: This is a single-centre retrospective study of patients referred for coronary CT angiography (CTCA) for investigation of stable chest pain in 2014. Their baseline clinical data such as demographics, CV risk profiles, CAS and CTCA results were obtained from electronic medical records. A combined clinical outcome of CV event, the need to undergo invasive coronary angiogram and revascularization over a period of 2 years were also traced.

Result: 130 patients with complete data were analyzed. The mean age was 54 ± 11.6 years. 66% (86 patients) were males and 32% (49 patients) were diabetics. There were 43% (56 patients), 30% (39 patients) and 27% (35 patients) in the low-, intermediate- and high FRS risk respectively. 36% (47 patients) had CAS zero and 33% (43 patients) had CAS <100. CAS of 100–399 and more than 400 had 15% (20 patients) respectively. CAS has higher sensitivity and negative predictive value in detecting obstructive CAD on CTCA compared to FRS (94.6%; 95%CI 81.81.8 to 99.3% and 94.8%; 95%CI 82.4 to 98.6% respectively). CAS has also higher sensitivity and negative predictive value in predicting 2-year CV outcome (97.4%; 95%CI 86.2% to 99.9% and 97.9%; 95%CI 87.1% to 99.7% respectively) compared to FRS (91.2%; 95%CI 76.3 to 98.1% and 92.3%; 95%CI 79.8 to 97.3%).

Conclusion: Even in a population with a high CVD burden, there is a potential role of CAS in refining conventional risk stratification particularly in excluding presence of obstructive CAD and risk of CV outcome within 2 years.

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The Incidence and Clinical Relevance of Coronary Artery Anomalies Detected on Multidetector Computed Tomography in Sarawak

Y.Y. Oon^a, S.I. Khoo^a, H.S. Lim^a, N.H. Mohd Amin^a, K.T. Koh^a, C.S. Khaw^a, K.H. Ho^a, F. Shu^a, C.T. Tan^a, C.Y. Voon^a, N.Z. Khiew^a, A. Said^b, Y.L. Cham^a, A. Fong^a, T.K. Ong^a

^aDepartment of Cardiology, Sarawak Heart Center, Kota Samarahan, Kuching, Sarawak

^bFaculty of Medicine, University Malaysia Sarawak, Kota Samarahan, Kuching, Sarawak

Background: Coronary artery anomalies (CAAs) are rare. Some anomalies are associated with myocardial ischaemia, heart failure and sudden cardiac death.

Objectives: The aims of this study were to determine the incidence of CAAs detected on multidetector computed tomography (MDCT) and their clinical relevance.

Methods: We reviewed our center's MDCT database from January 2005 to December 2015.

Results: 76 out of 5677 (incidence 0.01%) patients were reported to have CAAs. They consisted of 44 patients (57.9%) with anomalous origin of right coronary artery (RCA), 7 (9.2%) with anomalous origin of left coronary artery (LCA), 3 (3.9%) with anomalous origin of the left circumflex artery (LCX), 1 (1.3%) with abnormal course of LCX, 15 (19.7%) with coronary artery fistulas, 3 (3.9%) with single coronary artery, 3 (3.9%) with anomalous left coronary artery from pulmonary artery (ALCAPA). We were able to retrieve 26 patients' (mean age 49 ± 13 years, 17 male) case folder. They consisted of 11 patients with anomalous origin of the RCA (10 from left coronary sinus), 4 with anomalous origin of LCA from right coronary sinus (3 inter-arterial course), 7 with coronary fistulas (2 large fistulas), 1 with single coronary artery (Lipton III, anterior course), 3 with ALCAPA. Out of the 26 patients, 24 (92.3%) were alive and 2 were lost to follow-up. The commonest presenting symptom was chest pain (65.4%), followed by dyspnea (34.6%) and heart failure (11.5%). 3 patients underwent surgery and 1 underwent transcatheter coiling of fistula. 4 patients had positive functional test (2 anomalous origin of RCA, 1 anomalous origin of LCA from right coronary sinus and 1 ALCAPA). Only 1 patient who had positive functional test underwent surgery. The remaining 3 who did not undergo surgery were still alive. The patient with single coronary artery presented with heart failure and remained alive with pharmacotherapy. All 3 ALCAPA patients were alive, with the oldest patient survived to age 71 years. None of them had surgery performed.